



NASA SBIR 2007 Phase I Solicitation

X3.01 Spacecraft Cabin Atmospheric Resource Management and Particulate Matter Removal

Lead Center: JSC

Participating Center(s): ARC, GRC, KSC, MSFC

Atmospheric resource management and particulate matter removal systems supporting critical needs for lunar mission architectures are requested. Vehicles and habitats are expected to be significantly restricted with respect to habitable volume and may operate at reduced atmospheric pressure with elevated oxygen concentrations. Improved non-regenerative and regenerative processes technologies for atmospheric quality control must be developed. The ability to economically supply atmospheric gases and refill storage tanks in flight will be needed. Isolating habitable volumes from surface dust and disposing of accumulated particulate matter will be challenges. Systems must be innovative and extremely efficient with respect to volume, mass, energy and thermal requirements.

Atmospheric Resource Management

Atmospheric resource management encompasses process technologies and equipment to supply, store, and condition atmospheric gases; provide gaseous oxygen at pressures at or above 3,000 psia; and achieve mass closure by recycling resources and using in situ resources. Typical process technologies employed for achieving these needs may include reduction of carbon dioxide to carbon, sub-critical gas storage, and electrolytic oxygen production with compression. Techniques for enhancing NASA's present capabilities and filling technology gaps are sought. The ability to provide early computer-based process technology predictive performance models for application scale-up and scale-down is desirable. Areas of emphasis include:

- **Carbon Dioxide Removal and Reduction for Recovery of Oxygen:** Process technologies for removing and sequestering carbon dioxide from cabin atmospheric gases (via means other than adsorption or chemisorption) and conditioning carbon dioxide for use in reduction processes to facilitate cabin mass balance closure are sought. Technologies to reduce carbon dioxide to a carbon product with high efficiency that yields a high percentage mass balance closure are also of interest.
- **Gas Supply and Storage:** Novel means for supplying and storing oxygen and nitrogen under sub-critical conditions that lead to enhancements in energy efficiency, reduced mass and volume, and mission flexibility are sought. Further, process technologies leading to a ready, in-flight renewable source of 3,000-psia gaseous oxygen are of interest.

Particulate Matter Removal and Disposal

Dust and particulate matter contamination are challenges that must be overcome for lunar surface exploration. Particulate contamination originating from the external surface environment or from internal sources are both of concern. Development of process technologies and equipment to minimize the impacts of surface dust on crew health and equipment inside the habitable volume are sought, including novel approaches to remove dust from

spacecraft cabin atmosphere and isolate habitable volumes from surface dust. Candidate technology solutions should provide high efficiency and long-lived removal capacity. Technologies must be tolerant to the abrasive effects of dust particles. Performance should be demonstrated with appropriate lunar dust analogs or simulants. Areas of emphasis include:

- **Removal of Fine Atmospheric Dust Particulates:** Fine airborne lunar dust will be detrimental to crew health. Filtration technologies are sought that will provide significantly improved capture efficiency of both fines (10 nm to 2 microns) and ultra-fines (
- **Regenerative Processes and Filters:** Regeneration techniques and regenerable filters are sought that effectively handle a broad particulate size range from larger-sized particles down to fine particle sizes. These techniques must be able to separate and dispose of lunar dust to the lunar surface, and/or dispose of and collect all other particulate matter to highly compacted units/states. Salient features for this application include capability for regeneration in place, long-lived and large bulk removal capacity, and high efficiency. Operational modes of continuous regeneration or long interval regeneration cycles using either single or multi-stage regeneration processes will be considered. Methods for determining and annunciating the loading and unloading status of the regenerative unit and for automated regeneration are of interest.
- **Isolation Technologies:** Process technologies and design concepts to isolate habitable volumes from surface dust are sought. Such process technologies and design concepts may employ a variety of techniques to prevent surface dust from being transported through an airlock into the habitable part of the spacecraft or habitat cabin.